Abstract Draft

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Additive Manufacturing (AM) of metallic structures, in particular Selective Laser Melting (SLM) of Ti-Al_6-V_4 ($Ti_{6,4}$) has gained significant interest from the biomedical and aerospace industries due to the high strength to weight ratio and corrosion resistance of $Ti_{6,4}$, and the ability of SLM to accurately produce complex structures with minimal waste, that traditional methods cannot . SLM of $Ti_{6,4}$ involves several process parameters that all influence the microstructure and the presence of defects such as porosity in the final produced part. Consequently the understanding of these process parameters and their effects play a vital role in optimising the mechanical and material properties of the final produced $Ti_{6,4}$ part.

The goal of this project is to facilitate a greater use of in-situ process monitor data in order to help identify types of processing defects in near real time, as well as to help facilitate enhanced SLM process control. Going forward the objective is to use the in-situ process monitoring data to help facilitate predictive process control. In this case the data being produced in-process would inform the operator of a potential defect. Current QA methods such a Computer Tomography (CT) scanning while accurate, is a time consuming process. Post process data analytical algorithms such as the Generalised Extreme Studentized Deviate (GESD) test have proven successful in identifying defective layers in $Ti_{6,4}$ lattice structures produced by the Renishaw 500M SLM machine. The data required for defect detection was acquired through the in process data monitoring system *InfiniAM* using co-axial diodes to monitor meltpool emmissions and a seperate diode to monitor and laser power. Implementation of this technique in near real time would significantly improve part quality and reduce process waste, as in process defect detection would allow for the defect to be detected in near real time, and corrective action to be taken. Present post process defect detection methods in SLM printing while accurate, do not enable defect correction as the defect has already been produced.

The use of data generated throughout the manufacturing process for data driven optimisation, or *'Smart Manufacturing'* is one of the key proponents of Industry 4.0, which describes the growing importance of automation and data ex-

change in industry. The potential use of the data generated in the SLM process, and being detected by the InfiniAM Spectral Software to inform the operator of a potential defect is an example of Smart Manufacturing and data driven process optimisation.